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DEVELOPMENT OF CHEMISTRY STUDENT WORKSHEET WITH INDUCTIVE-DEDUCTIVE APPROACHES AS A PREVENTIVE MEANS TO THE MISCONCEPTION ON CHEMICAL BONDING MATERIAL STUDENTS AT SENIOR HIGH SCHOOL GRADE 10th

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Abstract

The aims of this research are to know the advisability of chemistry student worksheet with inductive-deductive approach as a preventive means to the misconception on chemical bonding material in terms of validity, practicality and effectiveness. This research has been taken place in SMA Negeri 1 Cerme-Gresik on December 2017. Limited trials were conducted to 15 students. This research was conducted done for three meetings. Validity was obtained from the validation of student worksheet by 2 lecturers of chemistry and one chemistry teacher using validity sheet. Practicality was obtained from the result of questionnaire of student response to student worksheet supported by observation data of student's activity. Effectiveness was obtained from the results of student's misconception tests after the implementation of limited trials of 15 students. Instruments that used in this research were observation sheet activity, questionnaire, observation sheet student's responses and misconception test sheet. It can be concluded that (1) the chemistry student worksheet validation result of content criteria, linguistic criteria, presentation criteria, graphic criteria respectively as follows 86.11%; 82.78%; 85.34%; 85.00% in very valid category, (2) The percentage of student responses based on content criteria, linguistic criteria, presentation criteria, graphic criteria respectively as follows 94.00%, 86.67%, 95.55%, 84.44% in very practice category, (3) Misconception test results in chemical bonding materials showed that all students have percentage under 45.00% of very low misconception. Thus, the chemistry student worksheet that has been developed was feasible based on thatthree findings. Chemistry student worksheet with inductive-deductive approach concluded feasible to be used but still need to be done last phase from Thiagarajan development that disseminate.
Keywords: Development Research, Inductive-Deductive Approach, Preventive, Misconception, Chemical Bonding

INTRODUCTION

Chemical bonding is one of the materials in chemistry subjects. Chemistry subjects are subjects with submicroscopic (abstract), macroscopic (observable with sensory) and symbolic material [1]. Chemical bonding material is full of abstract concepts that conform to Pabuccu's opinion that the chemical bonding material is considered elusive [2], because chemical bonding is one of the submicroscopic chemicals, for example: unable to see atoms, ions, chemical structures, how binding occurs, and how to react with other atoms [1]. Based on the criteria of chemistry subjects, especially on the chemical bond material is expected teachers can build the concept of existing concepts so that the material can be received properly and correctly by students so that no misconception occurs.

Misconception is a false idea or view of a concept that belongs to a person different from the concepts agreed upon and deemed correct by the expert, usually these (different) views are resistant and presistent, this view is difficult to change [3].

Understanding the concept of students is divided into three types of understanding, namely to know the concept (NC), do not know the concept (DNC), and misconception (MC) [4]. Definition of the three types of understanding, are students who have a concept of understanding in accordance with scientific principles, students DNC is a student who does not understand about the concept in question scientifically, students of the constitutional court is a mismatch of student concepts with a scientific understanding formulated by scientists in their field [5]. The phenomenon of this misconception becomes an obstacle to the learning process due to the mismatch of student's concepts with scientific understanding formulated by scientists in their field [6].

Tan and Treagust found one of the chemical concepts that still create misconceptions in learning is the concept of chemical bonds [7]. Previous studies have found that the concept of chemical bonding is accepted misconceptions by

students based on the following data: (1) Redhana and Kirna studies suggest the average student with misconceptions at high chemical bonds 63.4% [8], (2) Rahman et al. stated that the average student who misconception on chemical bond is 19.8% [9], (3) Yunianingsih research states the average of students who misconception in chemical bond is 16.00% [10]. (4) Hidayat research conducted revealed that Remedial learning with misconception strategy has succeeded in significantly decreasing the burden of misconception by 75% [11]. Based on the findings and previous studies it can be concluded that the concept of chemical bonding still encounters misconceptions. Whereas chemical bonds matter is include one of the basic concepts for chemical concepts in subsequent chemicals.

Following up the facts related to misconceptions it is necessary to prevent the occurrence of misconceptions on the concept of concepts that exist in chemical bonds. Prevention of misconceptions can be done by looking at the causes of misconceptions. According to Yip misconception mainly arises from three sources such as: (1) Naïve ideas arising from everyday experiences and language usage of learners; (2) Erroneous concepts formed by the learners during the lessons due to misunderstanding or lack of understanding; dan (3) Misconceptions passed from teachers through wrong or inaccurate teaching [12]. Based on the expression described by Yip, the thing that often leads to misconception is the explanation from the teacher that is not supported by the appropriate teaching materials or in accordance with the level of material difficulty and learning characteristics of students in understanding a chemical concept. One of the prevention means that can be taken is to improve the delivery of the concept correctly and precisely and also to support by learning sources that do not cause misconception.

One source of learning is by the existence of teaching materials. Teaching materials are all forms of materials used to assist teachers in carrying out teaching and learning activities in the classroom. Quality teaching materials are teaching materials whose material can answer problems to achieve learning objectives [13]. Included is the Chemistry Student Worksheet as a teaching material that can be used to demonstrate misconceptions.

Chemistry Student worksheet is a sheet containing guidelines for students to carry out programmed activities [14]. This sheet contains instructions, guidance questions, and understanding so that students can expand and deepen understanding of the material being studied. Inductive strategies or other names of learning from the general to the Inductive strategy of the material being studied starting from the concrete or the examples of which then slowly the students are exposed to complex and difficult material. Inductive learning begins with giving cases, facts, examples, and causes reflecting a later concept or principle, students are led to strive to synthesize, announce or conclude the principle of the lesson [15]. Meanwhile, the deductive approach is almost the same as the inductive approach in terms of goals to be achieved. The deductive learning approach begins with a definition of concept or generalization followed by an example illustration. What distinguishes these two approaches is the sequence in which the example example is presented [16].

Providing facts, examples and non-examples on the Inductive-Deductive approach can prevent misconceptions because in the process of implementation it is expected that teachers can guard students in determining a concept through acquiring characteristics of the concept to be conveyed by the teacher so that, in the development of student worksheet with this Inductive-Deductive approach students think gradually complex. Inductive -Deductive approaches can prevent misconceptions. In Inductive learning, in the open-ended phase students are presented examples of examples and non-examples of concepts to be found, teachers guide students to examine examples and non-examples so that, in this phase students express their opinions on the regularities that appear in the concept example. Furthermore, Convergen's phase, the teacher eliminates opinions that are inconsistent with the concepts studied, the characteristics that appear in the concept examples. The third phase is the Closure phase, in this phase of this phase the teacher must make sure the concept is delivered well. Teachers play an important role in this section because in this phase students find concepts and construct concepts (definitions, characteristics and examples that include concepts) with the language he understands. While deductive learning can prevent misconceptions. Deductive learning begins by conveying the concept. At this stage the teacher should make sure that the concepts put forward are well received by the students, the concepts put forward are clear, easily accepted and understood by the students [17]. In deductive learning, emphasis is placed on the early phases of presentation of abtraction concepts and this is an

important phase in deductive learning in order to prevent misconceptions.

Based on the misconception data that occurs in chemical bonds if these misconceptions are allowed to be sustained or no prevention efforts then students will experience misconceptions in the next chemicals and students will have difficulty in receiving the next material. Therefore, chemistry student worksheet developed with inductive-deductive approach of material about chemical bond especially ionic bond and covalent bond can prevent misconception. Thus the authors conducted a study Development of Chemistry Student Worksheet (CSW) with Inductive-Deductive approach as a Preventive means to the Misconceptions on Chemical Bonding Material Students at Senior High School Grade 10th.

METHOD

Research validity data is obtained from the validation of student worksheet by 2 lecturers of chemistry and one chemistry teacher using validity sheet. Practicality is obtained from the result of questionnaire of student response to student worksheet supported by observation data of student activity. Effectiveness was obtained from the results of student's misconception tests after the implementation of limited trials of 15 students. Data analysis used is quantitative and qualitative. Analysis of advisability test results of chemistry student worksheet, including:

1) Validity

The validation data of Chemistry Student Worksheet by Chemistry lecturer was analyzed by using quantitative descriptive methods that is giving description and describing research on Chemistry Student Worksheet with percentage of scores on the validity sheet. The percentage of this questionnaire data was obtained based on the Likert scale calculation in Table 1.

Table 1 Likert Scala

Assesment	Scale Value
Very less	1
Less	2
Enough	3
Good	4
Very Good	5

(Adaptation from Riduwan, [12])

The formula used:

$$\boldsymbol{P}(\%) = \frac{\boldsymbol{scores\ the\ results\ of\ data\ collection}}{\boldsymbol{criterion\ score}} \times \mathbf{100}\%$$

Score criterium = highest score in each item x number of items x number of respondents.

The results of the analysis obtained percentage which then interpreted into Table 2.

Table2 Interpretation of Scores

Percentage (%)	Category
0 – 20	Very Less Valid
21 – 40	Less Valid
41 – 60	QuiteValid
61 – 80	Valid
81 – 100	Very Valid

(Adaptation from Riduwan, [12])

Chemistry student worksheet is considered feasible if the results of the assessment are on valid category (61-80%) or very valid category (> 81%).

2) Practicality

Analysis of practical data Chemistry Student Worksheet obtained from the observation response sheet user where in this study are students. Data result of student response is analyzed descriptively quantitative that result of observation is described to give description about actual reality from result of research which has been done.

Table 3 Guttman Scale

Answer	Value
Yes	1
No	0

(Adaptation from Riduwan, [12])

The formula used:

$$\boldsymbol{P}(\%) = \frac{\boldsymbol{scorestheresultsofdatacollection}}{\boldsymbol{criterionscore}} \times \mathbf{100}\%$$

Score criterium = highest score in each item x number of items x number of respondents

The results of the analysis obtained percentage which then interpreted into the score as in Table 4.

Table 4 Interpretation of Scores

Percentage (%)	Category
0 – 20	Very Less practice
21 – 40	Less practice
41 – 60	Quite practice
61 – 80	Practice
81 – 100	Very practice

(Adaptation from Riduwan, [12])

It is said to be feasible if the results of the study are on the practice category (61-80%) or very practicecategory (> 81%)

3) Effectiveness

Effectiveness was obtained from the results of student's misconception tests after the implementation of limited trials of 15 students.

Trial is done to students who have received Chemical Bond material. This analysis is to find out what percentage of student misconceptions after using the chemistry student worksheet with an inductive-deductive approach. 12 items on the Three Tier misconception test. A misconception analysis will be performed on each item.

Table 5 Criteria of Assessment Misconception

Percentageof misconception(%)	Category
0-45	Very low
46-55	Low
56-65	Middle
66-79	High
80-100	Very high

(Adaptation from Riduwan, [12])

Chemistry student worksheet (CSW) is considered feasible if the results of student's misconception were not more than 45%.

RESULTS AND DISCUSSION

A. Chemistry student worksheet Validation

Data validation results by lecturers of chemistry education courses and chemistry teachers are presented in Table 5.

Table 5 Chemistry student worksheet (CSW) validation results in general

NO.	Rated aspect	Percentage of Average Rating (%) and Category		
		CSW 1	CSW 2	CSW 3
1	Content Criteria	86.67	85.00	86.67
		Average percentage = 86.11 (very valid)		
2	Linguistic Criteria	80.00	83.34	85.00
		Average percentage = 82.78 (very valid)		
3	Presentation Criteria	86.67	85.72	83.81
		Average percentage = 85.34 (very valid)		
4	Graphic Category	86.67	85.00	83.34
		Average percentage = 85.00 (very valid)		

The result of validation of CSW I ionic bond, CSW II Covalent bond and CSW III the physics properties of ionic and covalent bonds on the content criteria of 86.11% with very valid category; linguistic criteria of 82.78% with very valid category; presentation criteria of 85.34% with very valid category; the graphic criteria of 85.00% with very valid category, it indicates that chemistry student worksheet that develop fulfill the criteria of validity.

B. Data on Student Response to Chemistry student worksheet

Results of student responses obtained from students' opinions on Chemistry student worksheet with inductive-deductive approach as a preventive means to the misconception on chemical bonding material through filling the questionnaire of student responses. The statement presented in the student response questionnaire with the choice of "yes" and "no" answers The results of the filling are then calculated and changed in the form of percent and then determined the criteria corresponding to the percentage results. The following presented the results of student responses to the developed Chemistry student worksheet.

Table 6 Results Student Response Questionnaire

No.	Rated aspect	Precentage (%)	Information
1.	Content Criteria	94.00	Very practice
2.	Linguistic Criteria	86.67	Very practice
3.	Presentation Criteria	95.55	Very practice
4.	Graphic Category	84.44	Very practice

C. Observation Data of Student Activity

Data of observation result of student activity is obtained from observer observation to student activity during Chemistry student worksheet meeting. Data obtained from observation 3 observer, 2 observers observed each 2 groups and one observer observed 1 group. Each observer observed 11 types of student activities. Observer is given observation sheet of student's activities observer will only observe dominant aktvitas done by student every 3 minute during trial process take place. Data result of student activity observation is supporting data for student response to know feasibility of CSW in terms of practicality. The following table data the results of observation activities as a whole.

Table 7 Data on Student's Activity Observation Results

No.	Meeting	Percentage (%)	
		Relevant Activities	Not-Relevant Activities
1.	Meeting I	94.67	5.33

No.	Meeting	Percentage (%)	
		Relevant Activities	Not-Relevant Activities
	Trial of CSW I Ion-Inductive Bonds		
2.	Meeting II Trial of CSWII Covalent-Deductive Association	97.33	2.67
3.	Meeting III Trial of CSWIII Physical Properties of Ionic Bond and Covalent-Inductive Bond	98.00	2.00

Based on the observation data of student activity in Table 4.7 it can be seen that in the implementation of chemistry student worksheet with inductive-deductive approach as a preventive means to the misconception on chemical bond material percentage of relevant activities greater than the activity that not relevant. Seen conformity between the student's respons to the activities undertaken by the student during the trial took place.

D. Data on Student Misconception Test Result

These misconception test results were obtained from a limited trial data retrieval process with a three-tier misconception test related to chemical bonds, especially ionic, covalent and characteristic bonds. This test is given after students learn by using chemistry student worksheet with inductive-deductive approaches as a preventive means to the misconceptions. This misconception test is given to determine the effectiveness of the developed the worksheet. Student misconceptions are identified through a concept comprehension test consisting of 12 multiple choice questions complemented by the choice of reason and level of confidence of "sure" or "unsure" students. This concept comprehension test uses a Three-tier diagnostic test to find out the misconceptions that occurred after testing the worksheet. The test given in the form of multiple choice questions with answering belief can be used to identify student misconceptions [4].

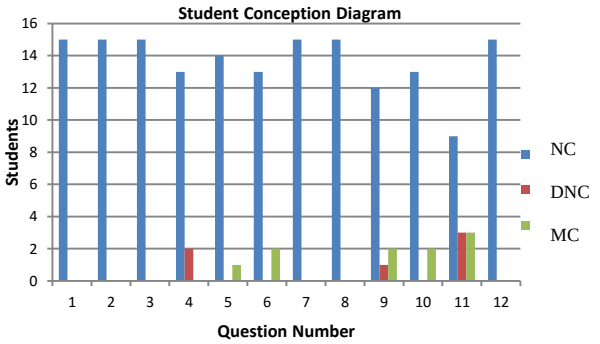

Figure 1 Student Conception Diagram On Three-Tier Misconception Test

Figure 1, the misconception data of the misconception test results are limited to inductive-deductive student worksheet.In Figure 1 it can be seen that there is still some students who experience misconception. From the results of the test students have misconception on the number 5, 6, 9, 10, 11, on each item there are 1-3 students still misconception. Here are some indicators of misconceptions, 1) Based on known atomic electronegativity data, students can accurately estimate the bonds that are formed; 2) Based on the data of known atomic electronegativity tables, students can accurately estimate the strength of ionic bonds; 3) Students are able to understand chemical bonds, both disconnection and bond formation; 4) Through the exposure of facts in everyday life, students can understand the cause and purpose of chemical bonding correctly.

Misconceptions can occur because of different perceptions. The misconception occurs due to the influence of perception, the interference of everyday language, abstract characters of the learned concepts. Some students who still experience misconceptions on some of the above indicators occur because there is emphasis should be noted that 1) the active role of students in constructing knowledge meaningfully; 2) the importance of making the connection between ideas in construct meaningful; 3) linking ideas with new information received. Awareness of students in learning needs to be improved again so that students learn more meaningful and can receive the material appropriately. After being traced and synchronized with students responses, misconception activities and tests, students who still experience misconceptions on a particular problem are students who believe that the developed the worksheet does not help distinguish concepts and does not follow the lessons well seen from the activities during the pilot activities. While for item number 9, the worksheethas not explained about the involvement of bond energy in bond

formation so that students still experience misconception after using chemistry student worksheet with inductive-deductive approach. So that the content of chemistry student worksheet should be added to the involvement of bonding energy in the process of bond formation or disconnection of bonds.

Table 8 Table Percentage of Three-Tier Misconception Problem.

Student	NC	DNC	MC	% MC
S1	12	0	0	0
S2	11	1	0	0
S3	10	0	2	16.67
S4	12	0	0	0
S5	11	0	1	8.33
S6	11	1	0	0
S7	10	2	0	0
S8	12	0	0	0
S9	12	0	0	0
S10	10	1	1	8.33
S11	11	0	1	8.33
S12	11	0	1	8.33
S13	10	1	1	8.33
S14	11	0	1	8.33
S15	10	0	2	16.67

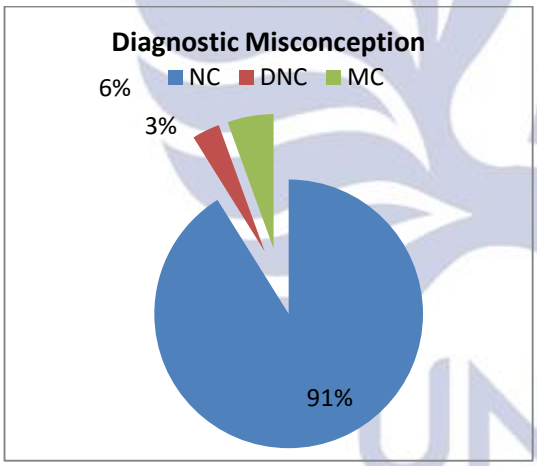

Figure 2 Percentage Student Conception Diagram on Three-Tier Misconception Test

Based on table 8 and figure 2,data of 12 questions done by 15 students after learning using Chemistry student worksheet inductive-deductive approaches as a preventive means to the misconception obtained the facts as follows: (1) learning with inductive-deductive approach able to preventing misconception through phase phase in inductive-deductive requires extra attention so that students do not experience misconceptions, learning with an inductive-deductive approach can build students construct the concept well and make sure that understood is not misconception. (2) Several students with misconceptions status do not change their misconceptions status, this is because students are still carried on the initial understanding and the condition of students who are less able to reasoning questions. Chemistry student worksheet with inductive-deductive approach is effectively used in the preventive means to the misconception on chemical bonding material seen from the percentage student misconception in 12 question. Thus, based on the data obtained research it can be concluded that chemistry student worksheet with inductive-deductive approaches as a preventive means to the misconception on the material Chemical bonds developed feasible valid use, practical and effective. This is in accordance with the teaching materials development guidance.

CLOSURE

CONCLUSION

Based on the results and discussion in the research entitled Development of Student worksheet with inductive-deductive approaches as a preventive means to the misconception on chemical bond material of high school students of 10^{th} grade, this CSW developed can be said feasible based on the following findings:

1. The result of validation of CSW I ionic bond, CSW II Covalent bond and CSW III the physics properties of ionic and covalent bonds on the content criteria of 86.11% with very valid category; linguistic criteria of 82.78% with very valid category; presentation criteria of 85.34% with very valid category; the graphic criteria of 85.00% with very valid category, it indicates that chemistry student worksheet that develop fulfill the criteria of validity.
2. Student's response to chemistry student worksheet with inductive-deductive approaches as a preventive means to the misconception on chemical bond material developed, that is content criteria of 94.00% with very practical category; linguistic criteria of 86.67% with very practical category; presentation criteria of 95.55% with very practical category; graphic criteria of 84.44% with very practical category this indicates that the LKS fulfill the criteria of practicality.
3. Chemistry student worksheet with an inductive-deductive approaches is effectively used in the prevention of misconceptions on the chemical

bond material seen from the absence of a percent misconception of students is more than 45%. The percentage of student misconception test result is 8.33% - 16.67% this percentage is in very low misconception category.

SUGGESTION

Based on the results and discussion in the research entitled development of Student worksheet with inductive-deductive approaches as a preventive means to the misconception on the chemical bond material of high school students of class X this, can be advised researcher as input is:

1. Teacher should pay attention to the initial conception of the studentsin the learning process. Initial understanding of the students will be the basis of consideration for teachers in choosing the appropriate approach or strategy of learning and making tools and teaching instruments to make students understand the concept when the learning process is in progress.
2. In the trial process of preventive misconception teachers should pay attention to individual characteristics of students. Characteristics of individual students can be used as a basis for consideration for teachers to preventing misconceptions according to its characteristics.
3. The effectiveness gained from this research is feared to get interference from the learning that was done before the research because the experiment was conducted on the students who cause of misconception. So that can be given the right preventive means.

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